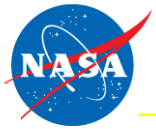
National Aeronautics and Space Administration
Goddard Institute for Space Studies

Goddard Space Flight Center
Sciences and Exploration Directorate
Earth Sciences Division

The 6th US Climate Modeling Summit

April 2nd - July 1st, 2020

Virtually chaired by Gavin Schmidt and Susanne Bauer (NASA GISS)



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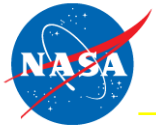
USCMS Goals:

Since 2015, an annual meeting of the six US climate modeling groups with interested program managers, in order to:

- Develop a shared understanding of modeling groups' directions and implementation strategies,
- Identify opportunities for enhanced coordination and synergy among modeling groups,
- Identify outreach opportunities to user communities

Since 2017, it has included a workshop on a topic of joint interest.



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USCMS in a time of COVID

Originally planned for April 2-3rd in Washington D.C.
Topical workshop focused on Global Model Cloud-Aerosol Research (GM-CAR)

As travel restrictions were implemented, this became impossible.

- Topical workshop split into four virtual weekly seminars: Apr 2nd–30th
- Main meeting rescheduled for two half day sessions Jun 30 & Jul 1

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USCMS Agenda

1. Summary of actions since USCMS-5 (2019)
2. Global Model Cloud-Aerosol Research (GM-CAR) workshop
3. Group updates
4. Community activities of relevance
5. Future collaborative projects
6. Planning for USCMS-7 (2021)

All presentations available at:
https://drive.google.com/drive/folders/1B_0HkjXPuNWOUtXrAQ8f-vzteD-6wYVu

Orbe et al (2020): Modes of Variability

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Representation of Modes of Variability in Six U.S. Climate Models

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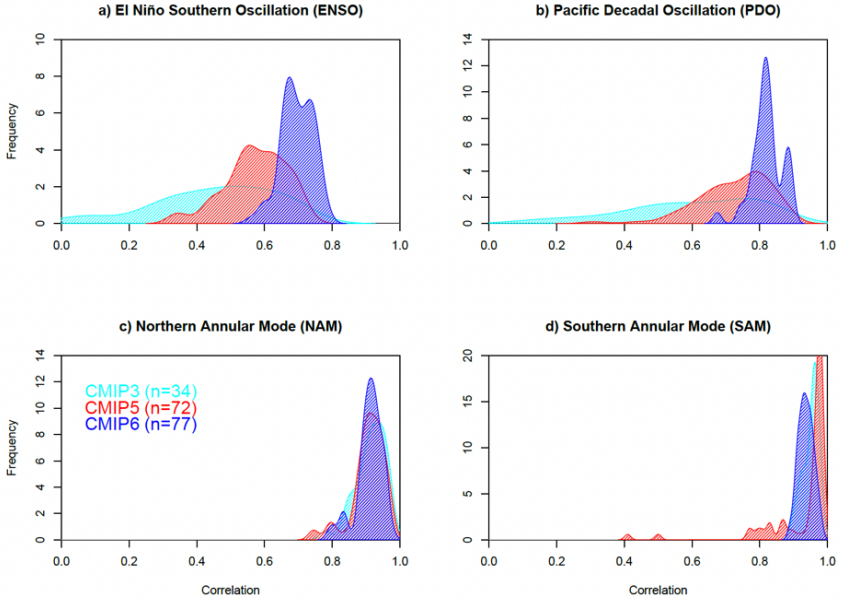
(Manuscript received 24 December 2019, in final form 27 April 2020)

ABSTRACT

We compare the performance of several modes of variability across six U.S. climate modeling groups, with a focus on identifying robust improvements in recent models [including those participating in phase 6 of the Coupled Model Intercomparison Project (CMIP)] compared to previous versions. In particular, we examine the representation of the Madden–Julian oscillation (MJO), El Niño–Southern Oscillation (ENSO), the Pacific decadal oscillation (PDO), the quasi-biennial oscillation (QBO) in the tropical stratosphere, and the dominant modes of extratropical variability, including the southern annular mode (SAM), the northern annular mode (NAM) [and the closely related North Atlantic Oscillation (NAO)], and the Pacific–North American pattern (PNA). Where feasible, we explore the processes driving these improvements through the use of ''intermediary'' experiments that utilize model versions between CMIP3/5 and CMIP6 as well as targeted sensitivity experiments in which individual modeling parameters are altered. We find clear and systematic improvements in the MJO and QBO and in the teleconnection patterns associated with the PDO and ENSO. Some gains arise from better process representation, while others (e.g., the QBO) from higher resolution that allows for a greater range of interactions. Our results demonstrate that the incremental development processes in multiple climate model groups lead to more realistic simulations over time.



Funding provided from NASA/DOE/NOAA via IGIM

Dunne et al (2020): Climate Sensitivity

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Geophysical Research Letters

Research Letter | Open Access

Comparison of equilibrium climate sensitivity estimates from slab ocean, 150-year, and longer simulations

John P. Dunne, Michael Winton, Julio Bacmeister, Gokhan Danabasoglu, Andrew Gettelman, Jean-Christophe Golaz, Cecile Hannay, Gavin A. Schmidt, John P. Krasting ... See all authors

First published: 23 July 2020 | https://doi.org/10.1029/2020GL088852

Go here for SFX

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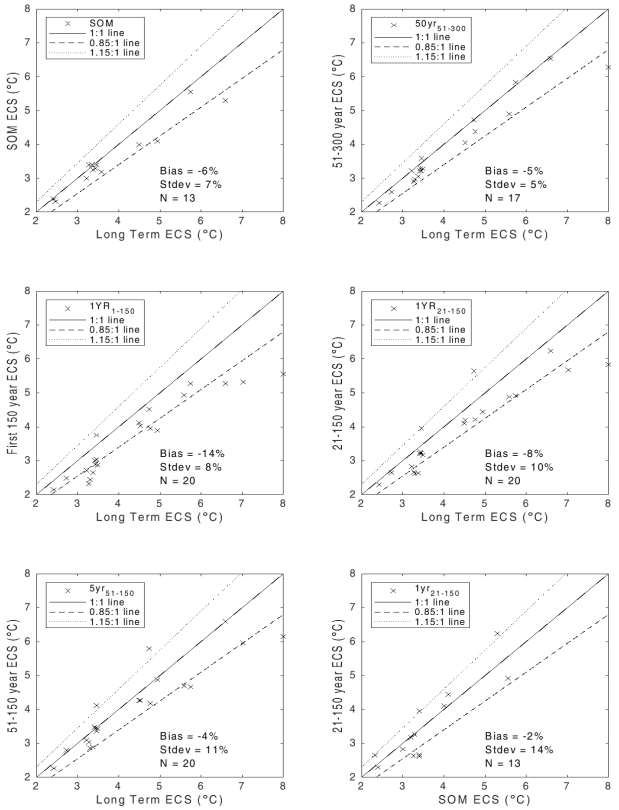
Abstract

We compare equilibrium climate sensitivity (ECS) estimates from pairs of long (≥ 800-year) control and abruptly quadrupled CO_2 simulations with shorter (150, 300 year) coupled atmosphere-ocean simulations and Slab Ocean Models (SOM). Consistent with previous work, ECS estimates from shorter coupled simulations based on annual averages for years 1-150 underestimate those from SOM (-8% ± 13%) and long (-14% ± 8%) simulations. Analysis of only years 21-150 improved agreement with SOM (-2% ± 14%) and long (-8% ± 10%) estimates. Use of pentadal averages for years 51-150 results in improved agreement with long simulations (-4% ± 11%). While ECS estimates from current generation US models based on SOM and coupled annual averages of years 1-150 range from 2.6°C to 5.3°C, estimates based longer simulations of the same models range from 3.2°C to 7.0°C. Such variations between methods argues for caution in comparison and interpretation of ECS estimates across models.



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Machine Learning Webinars

- Clear opportunity for ML/AI methods to contribute to GCM development/utilization/analyis.
- Multiple new initiatives:

(See summary from Ruby Leung)

Machine Learning in NWP Practice

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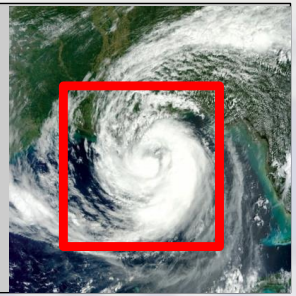
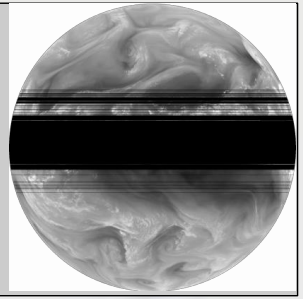
DATA UTILIZATION

-Tropical storms, extreme weather, storm damage, and forest fires detection.
-Retrievals or conversion of satellite radiances to model variables.



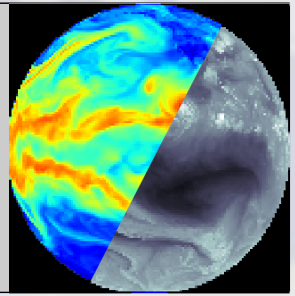
ENHANCEMENT

-Frame repair
-Feature extraction
-Cloud removal
-Gaps filling



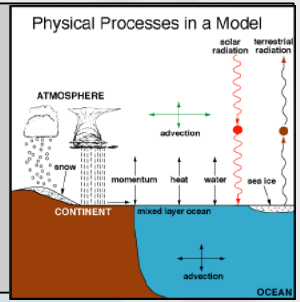
INITIALIZATION

Data Assimilation:
-Direct assimilation
-Better utilize surface observations
-Ecological modeling
-Adjoint



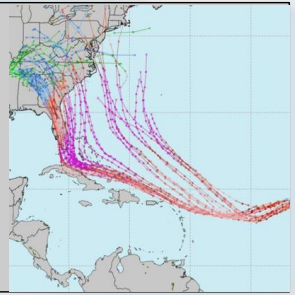
EMULATION

Fast Model Physics:
-Radiation
-Convection
-Microphysics
-PBL
Fast Chemistry
Fast Simplified GCMs



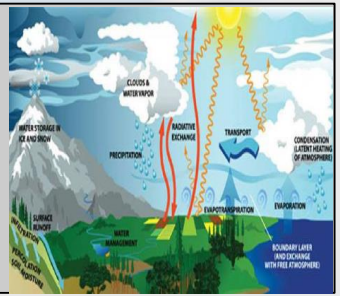
POST-PROCESSING

-Bias corrections
-Uncertainty prediction
-Storm track and intensity
-Ensemble averaging
-Multi-model ensembles



PARAMETRIZATION

New parametrizations:
-From data simulated by higher resolution models
-From observed data



V. Krasnopolsky

Global Model Cloud-Aerosol Research Workshop

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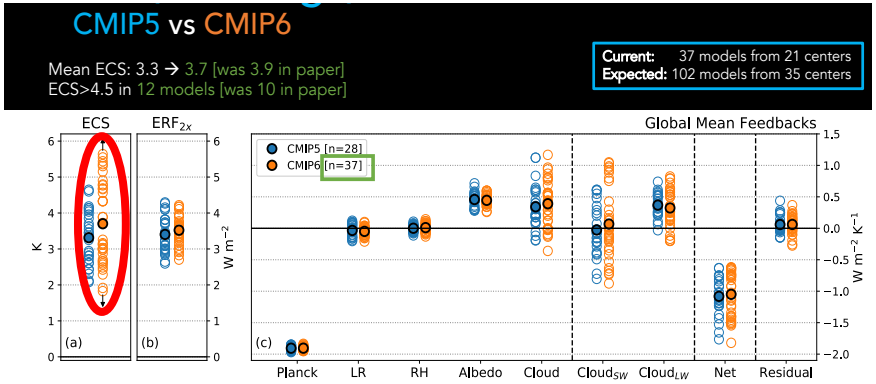
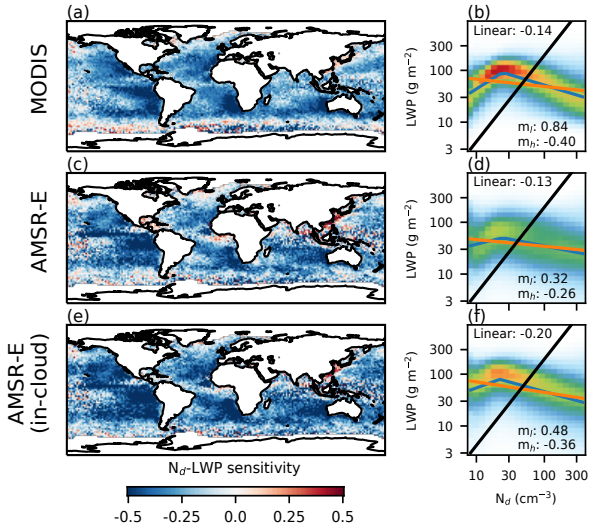
Goal: Given the evidence that divergence in Equilibrium Climate Sensitivity relates to cloud feedbacks, and is possibly linked to cloud and aerosol microphysics, the workshop examined the reasons for these divergences, commonalities and differences in parameterizations, process-based evaluation of the model outputs, & future research needs.





Presentations

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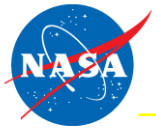
PDFs: https://www.dropbox.com/sh/3lx5k8phiiiu70i/AAAkU6VGFAGi6W-OpM88HOV7a?dl=0

Session 1: Climate Feedbacks and Equilibrium Climate Sensitivity.
Mark Zelinka (LLNL): Causes of high climate sensitivity in CMIP6 models
Andrew Gettelman (NCAR) Processes governing forcings and feedbacks.
Stephen Klein (LLNL): Climate Feedbacks in the WCRP Assessment on Climate Sensitivity

Session 2: Emerging constraints for aerosol – cloud interactions and cloud feedbacks
Johannes Mülmenstädt (PNNL) Can observations constrain parameterized processes?
Susannah Burrows (PNNL): Modelling and evaluating marine contributions to CCN and INP over the S. Ocn.
Ivy Tan (UMBC/GSFC): Physical Mechanisms Behind the Extratropical Cloud Optical Depth Feedback

Session 3: Part 1 Aerosol – Cloud Interactions in State of the Art Climate Models
Yi Ming (GFDL): A holistic approach toward modeling & understanding aerosol-cloud interactions
Po-Lun Ma (PNNL): Better cloud calibration leads to improved realism in global atmospheric simulation

Session 4: Part 2 Aerosol – Cloud Interactions in State of the Art Climate Models
Hailong Wang(PNNL): New aerosol treatments in E3SM and their impact on clouds
Andy Ackerman and Greg Elsaesser (GISS): Diversity of aerosol and cloud forcings in modelE3
Donifan Barahona (GMAO): Seasonal Predictions



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GM-CAR outcomes

- Clear Commonalities across model groups:
  - Cloud feedbacks have been a common target for improvement
  - More explicit cloud and aerosol microphysics has led to better climatologies
  - Connections between AIE and cloud feedbacks arise as part of the tuning *and* because of process connections
  - Many models have reduced erroneous –ve cloud phase feedbacks but this is not the (only) cause of higher ECS.
- Potential new joint activity to examine aerosol influence on cloud liquid water path in all USCMS models

Model Center updates

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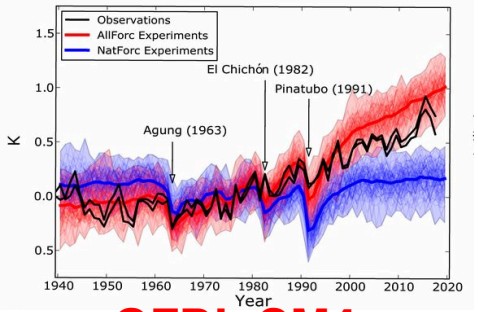
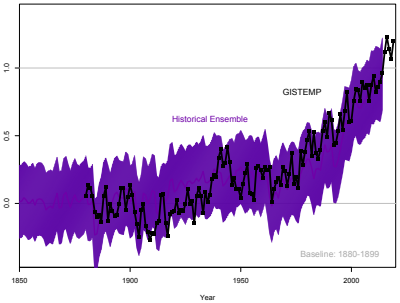
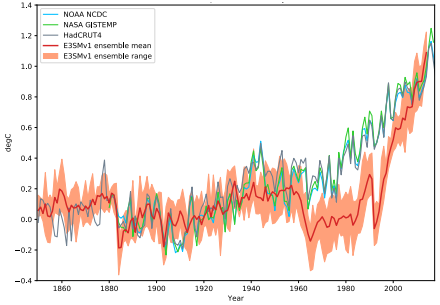
- Discussion related to CMIP6 activities:



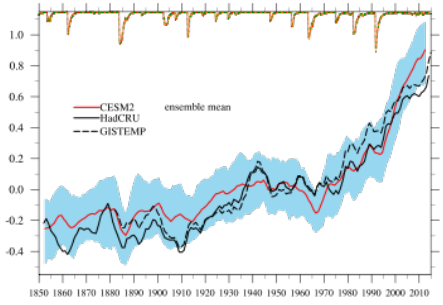
GFDL CM4



GISS ModelE2.1

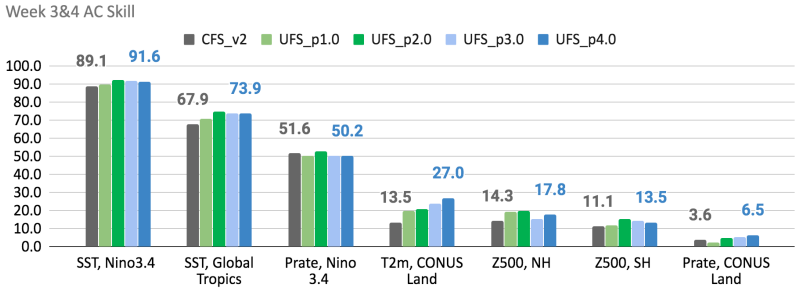


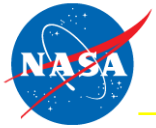
DOE E3SMv1



NCAR CESM2

- GMAO's M2-Ocean/MERRA-3
- NCEP's new UFS





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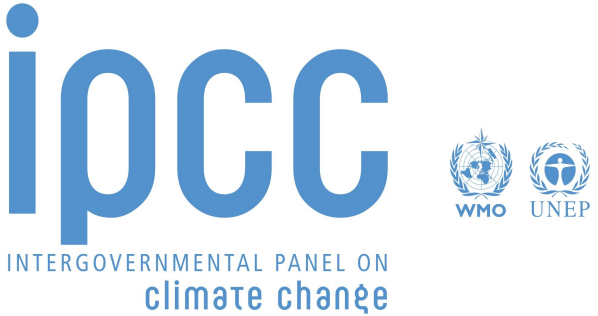
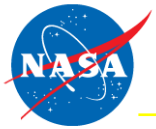
Relevant Community Activities

- Ongoing review of IPCC AR6
- Preparation for NCA-5
- FTAC on Earth System Predictability
- Planning/discussion for CMIP6+





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Next steps

- Planned collaborative activities:
  - GM-CAR follow-on proposal in work (Bauer et al)
  - “World Avoided” mini-MIP to examine impacts of Clean Air Acts (JF Lamarque)
  - COVID-19 impacts on air quality(/climate) (Pawson)
  - Time-slice approach to impacts for NCA?
- USCMS-7
  - Chairs: Susanne Bauer and Gokhan Danabasoglu
  - Workshop topic: Predictability
  - Dates: TBD